Space News Update

— January 13, 2017 —

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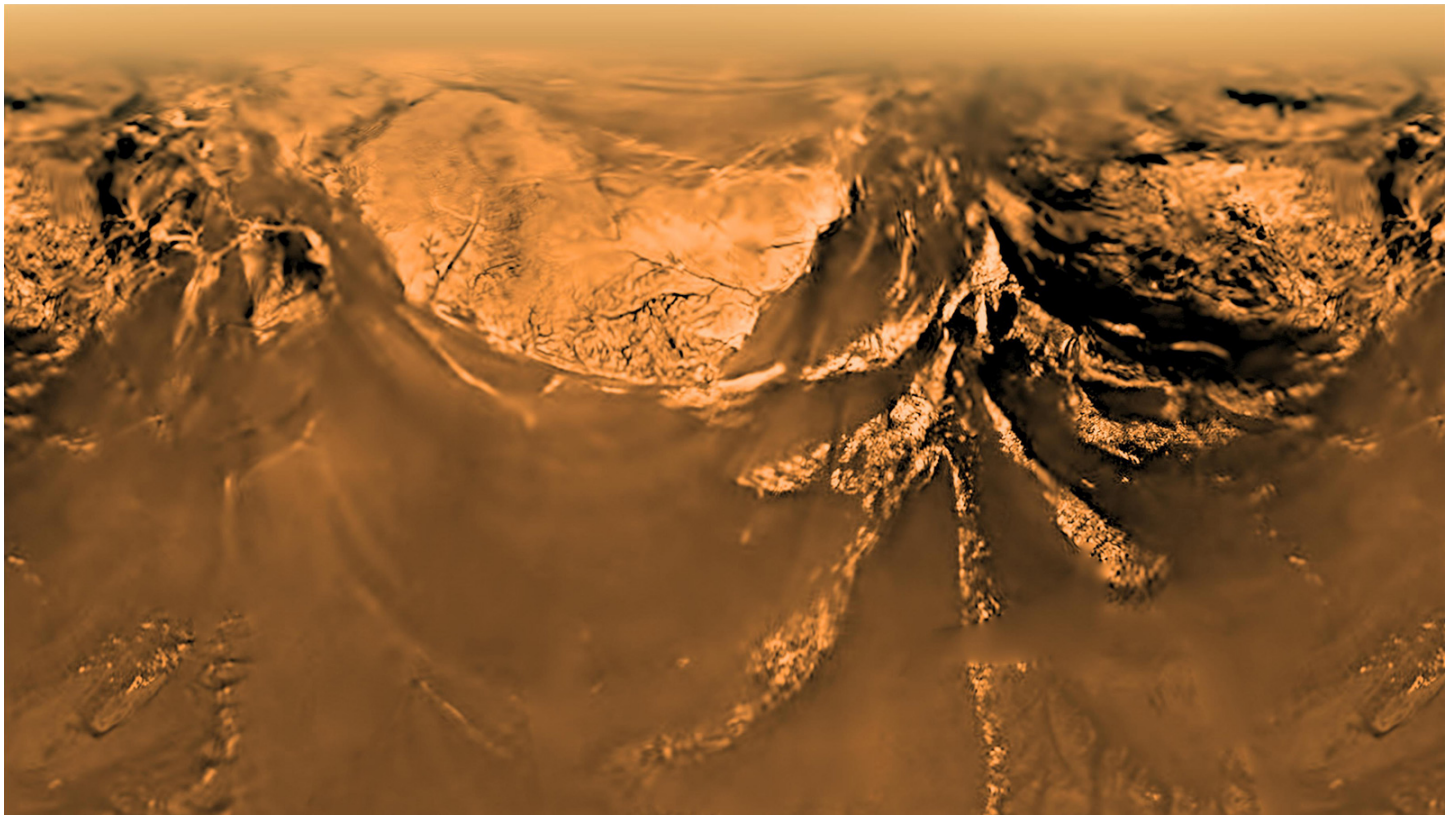
1. Huygens: 'Ground Truth' From an Alien Moon



2005 Historic Descent to Titan Revisited

After a two-and-a-half-hour descent, the metallic, saucer-shaped spacecraft came to rest with a thud on a dark floodplain covered in cobbles of water ice, in temperatures hundreds of degrees below freezing. The alien probe worked frantically to collect and transmit images and data about its environs -- in mere minutes its mothership would drop below the local horizon, cutting off its link to the home world and silencing its voice forever.

Although it may seem the stuff of science fiction, this scene played out 12 years ago on the surface of Saturn's largest moon, Titan. The "aliens" who built the probe were us. This was the triumphant landing of ESA's Huygens probe.

Huygens, a project of the European Space Agency, traveled to Titan as the companion to NASA's Cassini spacecraft, and then separated from its mothership on Dec. 24, 2004, for a 20-day coast toward its destiny at Titan.

The probe sampled Titan's dense, hazy atmosphere as it slowly rotated beneath its parachutes, analyzing the complex organic chemistry and measuring winds. It also took hundreds of images during the descent, revealing bright, rugged highlands that were crosscut by dark drainage channels and steep ravines. The area where the probe touched down was a dark, granular surface, which resembled a dry lakebed.

Thoughts on Huygens

Today the Huygens probe sits silently on the frigid surface of Titan, its mission concluded mere hours after touchdown, while the Cassini spacecraft continues the exploration of Titan from above as part of its mission to

learn more about Saturn and its moons. Now in its dramatic final year, the spacecraft's own journey will conclude on September 15 with a fateful plunge into Saturn's atmosphere.

With the mission heading into its home stretch, Cassini team members and NASA leaders look back fondly on the significance of Huygens:

"The Huygens descent and landing represented a major breakthrough in our exploration of Titan as well as the first soft landing on an outer-planet moon. It completely changed our understanding of this haze-covered ocean world."
-- Linda Spilker, Cassini project scientist at NASA's Jet Propulsion Laboratory, Pasadena, California

"The Huygens images were everything our images from orbit were not. Instead of hazy, sinuous features that we could only guess were streams and drainage channels, here was incontrovertible evidence that at some point in Titan's history -- and perhaps even now -- there were flowing liquid hydrocarbons on the surface. Huygens' images became a Rosetta stone for helping us interpret our subsequent findings on Titan."
-- Carolyn Porco, Cassini imaging team lead at Space Science Institute, Boulder, Colorado

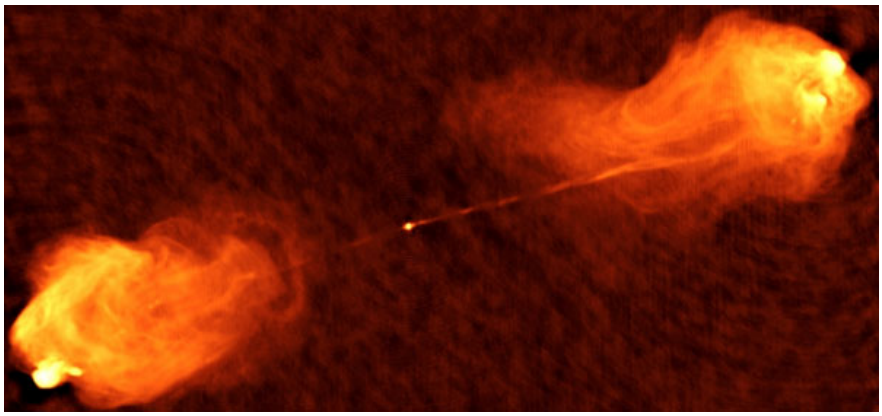
"Cassini and Huygens have shown us that Titan is an amazing world with a landscape that mimics Earth in many ways. During its descent, the Huygens probe captured views that demonstrated an entirely new dimension to that comparison and highlights that there is so much more we have yet to discover. For me, Huygens has emphasized why it is so important that we continue to explore Titan."
-- Alex Hayes, a Cassini scientist at Cornell University, Ithaca, New York

"Twelve years ago, a small probe touched down on an orangish, alien world in the outer solar system, marking humankind's most distant landing to date. Studying Titan helps us tease out the potential of habitability of this tiny world and better understand the chemistry of the early Earth."
-- Jim Green, director of planetary science at NASA Headquarters, Washington

A collection of Huygens' top science findings is available from ESA at: http://sci.esa.int/huygens-titan-science-highlights

Source: JPL Return to Contents

2. Mystery Object in Cygnus A Galaxy



The galaxy Cygnus A "shines" in radio frequencies (seen here), coming from relativistic electrons zipping along jets shot out from the central black hole and deposited in giant "radio lobes." (The lobes extend outward roughly 10 times farther than the galaxy itself, which is invisible in this image.)
NRAO / AUI

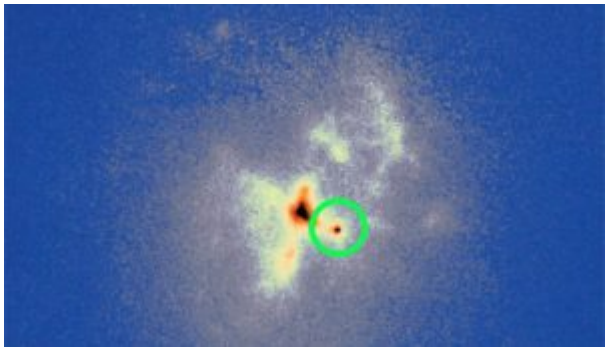
Last week at the American Astronomical Society meeting in Grapevine, Texas, astronomers made an announcement that's caught the interest of several researchers: a very bright *something* has appeared in a well-known galaxy.

That galaxy is the elliptical Cygnus A. Cygnus A is one of the brightest radio sources in the sky. It lies approximately 800 million light-years from us (redshift of 0.056). In its core sits a supermassive black hole madly eating and cocooned in gas, while two jets shoot out to either side and light up the intergalactic medium. This activity produces the radio radiation that makes Cygnus A so bright.

Using the recently upgraded Karl G. Jansky Very Large Array (VLA) in New Mexico, Rick Perley (NRAO) and colleagues took a gander at Cygnus A — the first time the instrument has looked at the galaxy since 1989. (Apparently astronomers spent so much VLA time observing the galaxy in the 1980s that they didn't feel the need to look again, Perley joked January 6th in his AAS presentation.) The new observations showed a surprise: a new, secondary object just southwest of the central black hole. This object wasn't in the 1989 radio image. Additional, higher-resolution observations with the Very Long Baseline Array also picked up the object, clearly distinct from the galaxy's nucleus. It's roughly 1,300 light-years from the center.

The whatever-it-is is about twice as bright as the brightest known supernova at these frequencies. In fact, it's much brighter than just about any transitory radio signal known, except for accreting supermassive black holes and *tidal disruption events*, outbursts created when a black hole eats a star.

The team scoured other archives and found the object in 2003 Keck infrared observations and, more iffily, in some images from Hubble. (The object is so red that it doesn't show up well at optical wavelengths, and in this range the space telescope's resolution isn't as good as that of Keck's adaptive optics.)



This false-color infrared image from the Keck II telescope shows the galaxy Cygnus A. Its central supermassive black hole is the large red-black splotch, but this 2003 image reveals a second, mystery source (circled) nearby.
G. Canalizo et al. / Astrophysical Journal 2003

The science session's attendees were aflutter with curiosity. Claire Max, who serves as director of the University of California Observatories (which manages both the Keck and Lick Observatories), went back and dug through Keck data and discovered that, in fact, astronomers *had* already discovered this source. In 2003 she, Gabriela Canalizo (now at University of California, Riverside), and colleagues had stumbled upon the mystery source. They, too, had gone back and found it in some Hubble images and not others — they weren't sure whether that was because the source was flickering, or just that Hubble hadn't looked long enough to consistently see it.

The team determined that the whatchamacallit wasn't a foreground object in the Milky Way, nor a cluster of young stars in Cygnus A. Rather, it seemed to be a compact cluster of old, red stars, with all the trappings of being the stripped-down core of a much smaller galaxy that Cygnus A had eaten. That minor merger might also explain why the big galaxy's black hole has "turned on," the astronomers suggested in their 2003 *Astrophysical Journal* paper.

On the other hand, Canalizo and colleagues went on to suggest in 2004 that the source might instead be a peek at the hot inner rim of the dusty doughnut enshrouding the black hole.

Perley's team favors a merger, too. But he advocated instead that the radiation might come from a second black hole, the leftover core of the eaten galaxy. If so, then Cygnus A is one of a few galaxies that seems to host a central binary black hole.

At the end of his presentation Perley called for others to look through their archival observations so that astronomers can pinpoint when this source appeared. His team is also looking in X-ray, but given that the central nucleus is so bright, they're not optimistic of their chances of seeing something, unless there's some variability. A formal paper and press release (with cool images!) are in the works, and when they're out we'll update you with more info.

Source: Sky & Telescope Return to Contents

3. The Moon is Older than We Thought, a New Study Says

For decades, scientists have been of the belief that the Moon, Earth's only natural satellite, was four and a half billion years old. According to this theory, the Moon was created from a fiery cataclysm produced by a collision between the Earth with a Mars-sized object (named Theia) roughly 100 million years after the formation of primordial Earth.

But according to a new study by researchers from UCLA (who re-examined some of the Apollo Moon Rocks), these estimates may have been off by about 40 to 140 million years. Far from simply adjusting our notions of the Moon's proper age, these findings are also critical to our understanding of the Solar System and the formation and evolution of its rocky planets.

This study, titled "Early formation of the Moon 4.51 billion years ago", was published recently in the journal *Science Advances*. Led by Melanie Barboni – a professor from the Department of Earth, Planetary, and Space Sciences at UCLA – the research team conducted uranium-lead dating on fragments of the Moon rocks that were brought back by the Apollo 14 astronauts.

Artist's concept of a collision that is believed to have taken place in the HD 172555 star system between a moon-sized object and a Mercury-sized planet. Credit: NASA/JPL-Caltech

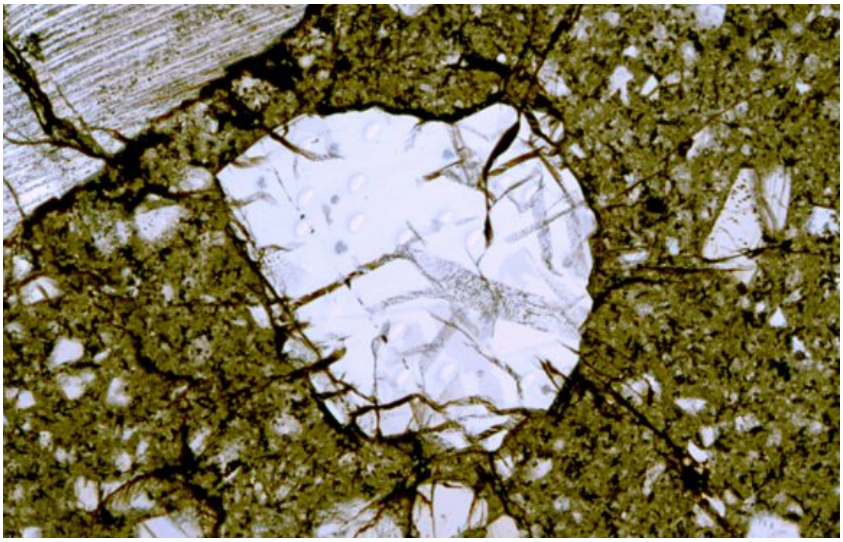
These fragments were of a compound known as zircon, a type of silicate mineral that contains trace amounts of radioactive elements (like uranium, thorium, and lutetium). As Kevin McKeegan, a UCLA professor of geochemistry and cosmochemistry and a co-author of the study, explained, "Zircons are nature's best clocks. They are the best mineral in preserving geological history and revealing where they originated."

By examining the radioactive decay of these elements, and correcting for cosmic ray exposure, the research team was able to get highly precise estimates of the zircon fragments ages. Using one of UCLA's mass spectrometers, they were able to measure the rate at which the deposits of uranium in the zircon turned into lead, and the deposits of lutetium turned into hafnium.

In the end, their data indicated that the Moon formed about 4.51 billion years ago, which places its birth within the first 60 million years of the Solar System or so. Previously, dating Moon rocks proved difficult, mainly because most

of them contained fragments of many different kinds of rocks, and these samples were determined to be tainted by the effects of multiple impacts.

However, Barboni and her team were able to examine eight zircons that were in good condition. More importantly, these silicate deposits are believed to have formed shortly after the collision between Earth and Theia, when the Moon was still an unsolidified mass covered in oceans of magma. As these oceans gradually cooled, the Moon's body became differentiated between its crust, mantle and core.



Zircon deposits found in the Moon rocks returned by the Apollo 17 mission. Credit: NASA//Nicholas E. Timms.

Because zircon minerals were formed during the initial magma ocean, uranium-lead dating reaches all the way back to a time before the Moon became a solidified mass. As Edward Young, a UCLA professor of geochemistry and cosmochemistry and a co-author of the study, put it, "Mélanie was very clever in figuring out the Moon's real age dates back to its pre-history before it solidified, not to its solidification."

These findings have not only determined the age of the Moon with a high degree of accuracy (and for the first time), it also has implications for our understanding of when and how rocky planes formed within the Solar System. By placing accurate dates on when certain bodies formed, we are able to understand the context in *which* they formed, which also helps to determine what mechanisms were involved.

And this was just the first revelation produced by the research team, which hopes to continue studying the zircon fragments to see what they can learn about the Moon's early history.

Further Reading: UCLA

Source: Universe Today Return to Contents

The Night Sky

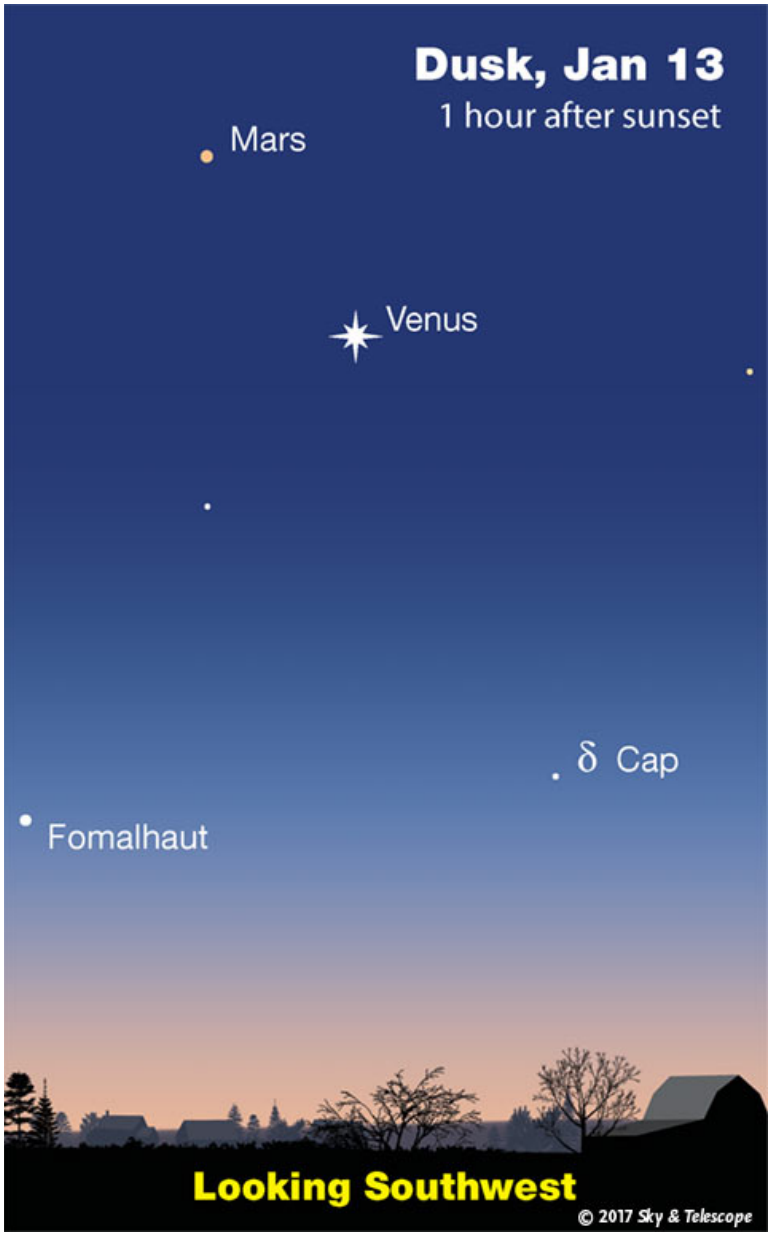
Friday, January 13
• How much Venus has brightened since December! It's now magnitude –4.6. Meanwhile, distant Mars has dwindled to +1.0.

• Here it is the coldest month of the year, but the "Summer Star," Vega, is still barely hanging in there. Look for it twinkling over the northwest horizon during and shortly after nightfall. The farther north you are, the higher it will be. If you're too far south it's already gone.

Saturday, January 14
• The waning gibbous Moon shines near Regulus after they rise around 8 p.m. Watch the distance between them increase through the night, as the Moon moves east along its orbit.

• In this coldest time of the year, the dim Little Dipper hangs straight down from Polaris after dusk — as if, per Leslie Peltier, from a nail on the cold north wall of the sky.

Sunday, January 15
• Zero-magnitude Capella high overhead, and equally bright Rigel in Orion's foot, are at almost the same right ascension. This means they cross your sky's meridian at almost exactly the same time: around 9 or 10 p.m. now, depending on how far east or west you live in your time zone. (Capella goes exactly *through* the zenith if you're at latitude 46° north: Portland, Oregon; Montreal; central France.) So, whenever Capella passes its very highest, Rigel always marks true south over your landscape. And vice versa.



Monday, January 16
• Orion is the brightest of the 88 constellations, but his main pattern is surprisingly small compared to some of his dimmer neighbors. The biggest of these is Eridanus the River, enormous but hard to trace. Dimmer Fornax the Furnace, to Eridanus's lower right, is almost as big as Orion! Even the main pattern of Lepus, the Hare cowering under Orion's feet, isn't much smaller than he is.

Tuesday, January 17
• Sirius twinkles brightly after dinnertime below Orion in the southeast. Around 8 or 9 p.m., depending on your location, Sirius shines *precisely below* fiery Betelgeuse in Orion's shoulder. How accurately can you time this event for your location, perhaps using a plumb bob or the vertical edge of a building? Of the two, Sirius leads early in the evening; Betelgeuse leads later. Welcome to pre-telescopic astronomy.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Jan 13, 5:53 AM	3 min	15°	13° above N	10° above NE
Sat Jan 14, 5:03 AM	< 1 min	10°	10° above NE	10° above NE
Sat Jan 14, 6:36 AM	4 min	40°	10° above NW	30° above ENE
Sun Jan 15, 5:46 AM	2 min	25°	22° above N	17° above ENE
Mon Jan 16, 4:56 AM	< 1 min	13°	13° above NE	10° above ENE
Mon Jan 16, 6:28 AM	4 min	84°	13° above NW	36° above SE
Tue Jan 17, 5:38 AM	2 min	49°	46° above N	29° above E

Sighting information for other cities can be found at NASA's Satellite Sighting Information

NASA-TV Highlights

(all times Eastern Daylight Time)

- **No Special Programming through Tuesday, Jan. 17th.**

Watch NASA TV on the Net by going to the NASA website.

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Space Calendar

- Jan 13 - Venus Passes 0.4 Degrees From Neptune
- Jan 13 - Comet P/2014 V1 (PANSTARRS) At Opposition (3.891 AU)
- Jan 13 - Comet 6P/d'Arrest At Opposition (3.899 AU)
- Jan 13 - Apollo Asteroid 2013 AS76 Near-Earth Flyby (0.089 AU)
- Jan 13 - Asteroid 2410 Morrison Closest Approach To Earth (1.197 AU)
- Jan 13 - Asteroid 9342 Carygrant Closest Approach To Earth (1.421 AU)
- Jan 13 - Asteroid 6469 Armstrong Closest Approach To Earth (1.665 AU)
- Jan 13 - Asteroid 784 Pickeringia Closest Approach To Earth (2.685 AU)
- Jan 14 - UPDATED [Jan 09] Iridium NEXT 1-10 Falcon 9 Launch
- Jan 14 - Comet C/2016 U1 (NEOWISE) Perihelion (0.319 AU)
- Jan 14 - Comet 190P/Mueller At Opposition (2.044 AU)
- Jan 14 - Comet C/2016 E2 (Kowalski) At Opposition (3.888 AU)
- Jan 14 - NEW [Jan 09] Apollo Asteroid 2017 AJ13 Near-Earth Flyby (0.017 AU)
- Jan 14 - Apollo Asteroid 438955 (2010 LN14) Near-Earth Flyby (0.060 AU)
- Jan 14 - NEW [Jan 06] Apollo Asteroid 2017 AY3 Near-Earth Flyby (0.075 AU)
- Jan 14 - Asteroid 2062 Aten Closest Approach To Earth (0.718 AU)
- Jan 14 - Asteroid 11246 Orvillewright Closest Approach To Earth (1.521 AU)
- Jan 14 - Asteroid 4221 Picasso Closest Approach To Earth (1.819 AU)
- Jan 14 - Wilhelm Beer's 220th Birthday (1797)
- Jan 15 - NEW [Jan 07] Moon Occults Regulus
- Jan 15 - Apollo Asteroid 265482 (2005 EE) Near-Earth Flyby (0.068 AU)
- Jan 15 - Asteroid 14593 Everett Closest Approach To Earth (1.009 AU)
- Jan 16 - Cassini, Distant Flyby of Janus, Atlas, Pallene, Daphnis
- Jan 16 - NEW [Jan 09] Moon Occults Asteroid 16 Psyche
- Jan 16 - Comet P/2015 TO19 (Lemmon-PANSTARRS) At Opposition (2.461 AU)
- Jan 16 - Comet 327P/Van Ness Closest Approach To Earth (2.790 AU)
- Jan 16 - NEW [Jan 08] Apollo Asteroid 2017 AN4 Near-Earth Flyby (0.063 AU)
- Jan 16 - Asteroid 1862 Apollo Closest Approach To Earth (1.193 AU)
- Jan 16 - Asteroid 4659 Roddenberry Closest Approach To Earth (1.350 AU)
- Jan 16 - Centaur Object 32532 Thereus At Opposition (11.818 AU)
- Jan 16-18 - ALMA Band 1 Science Workshop, Taipei, Taiwan
- Jan 17 - Cassini, Distant Flyby of Titan
- Jan 17 - Comet 143P/Kowal-Mrkos Closest Approach To Earth (2.892 AU)
- Jan 17 - Asteroid 51828 Ilanramon Closest Approach To Earth (1.508 AU)
- Jan 17 - Asteroid 4342 Freud Closest Approach To Earth (2.023 AU)
- Jan 17 - 15th Anniversary (2002), Galileo, Io 33 Flyby
- Jan 17 - Elisabeth Hevelius' 370th Birthday (1647)
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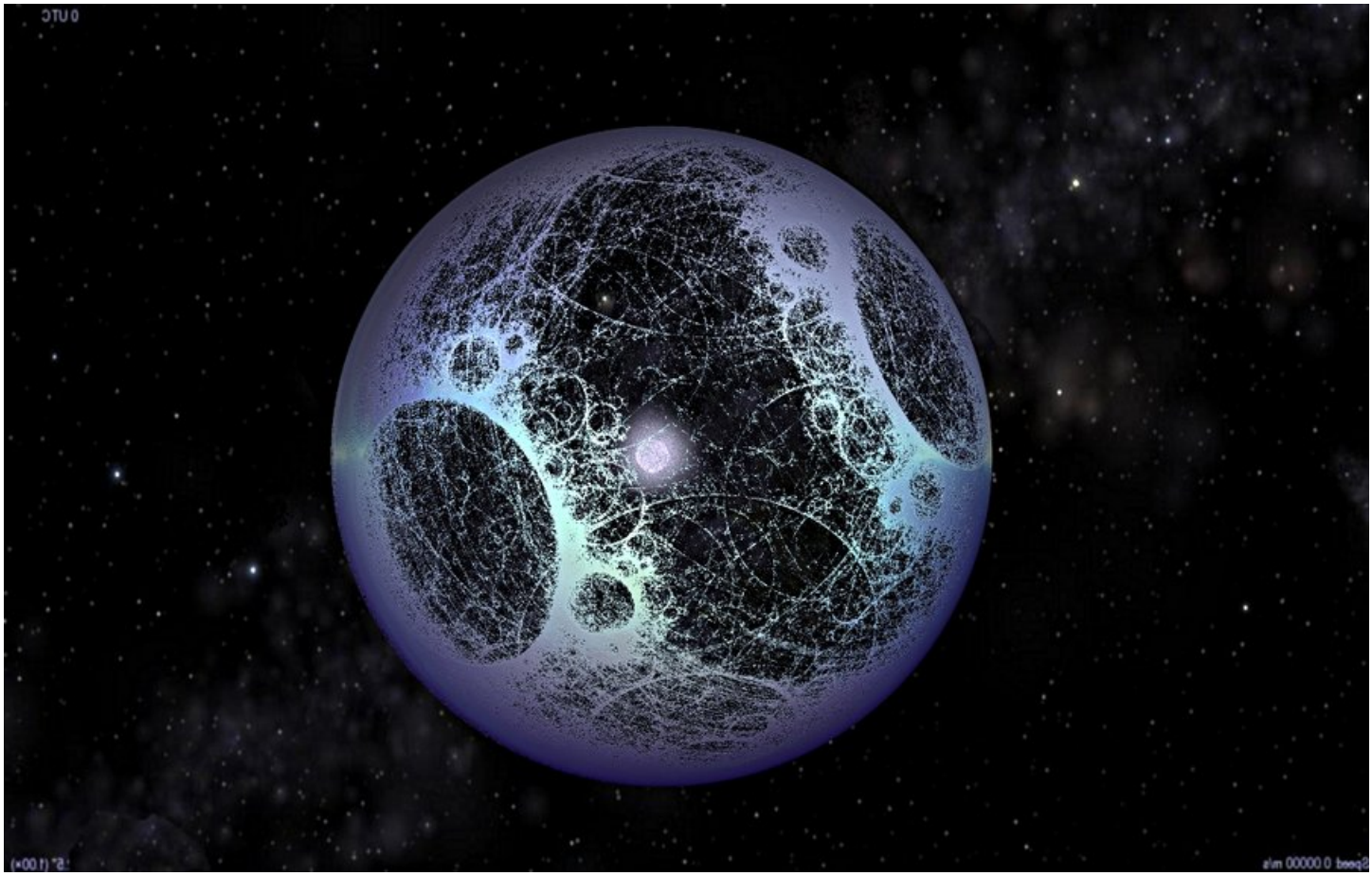
Source: JPL Space Calendar Return to Contents

Food for Thought

Finally, an explanation for the "alien megastructure?"



Back in October of 2015, astronomers shook the world when they reported how the Kepler mission had noticed a strange and sudden drop in brightness coming from KIC 8462852 (aka. Tabby's Star). This was followed by additional studies that showed how the star appeared to be consistently dimming over time. All of this led to a flurry of speculation, with possibilities ranging from large asteroids and a debris disc to an alien megastructure.

But in what may be the greatest explanation yet, a team of researchers from Columbia University and the University of California, Berkley, have suggested that the star's strange flickering could be the result of a planet it consumed at some point in the past. This would have resulted in a big outburst of brightness from which the star is now recovering; and the remains of this planet could be transiting in front of the star, thus causing periodic drops.

For the sake of their study – titled "Secular dimming of KIC 8462852 following its consumption of a planet", which is scheduled to appear in the *Monthly Notices of the Royal Astronomical Society* – the team took the initial Kepler findings, which showed sudden drops of 15% and 22% in brightness. They then considered subsequent studies that took a look at the long-term behavior of Tabby's Star (both of which were published in 2016).

The first study, conducted by **Bradley Schaefer of Louisiana State University**, showed a decrease of 14% between the years of 1890 and 1989. The second study, conducted by **Ben Monet and Joshua Simon** (of

Caltech and the Carnegie Institution of Washington, respectively), showed how the star faded by 3% over the course of the four years that Kepler continuously viewed it.

They then attempted to explain this behavior using the **Kozai Mechanism** (aka. Kozai Effect, Lidov-Kozai mechanism), which is a long-standing method in astronomy for calculating the orbits of planets based on their eccentricity and inclination. Applied to KIC 8462852, they determined that the star likely consumed a planet (or planets) in the past, likely around 10,000 years ago.

This process would have caused a temporary brightening from which the star is now returning to normal (thus explaining the long term trend). They further determined that the periodic drops in brightness could be caused by the remnants of this planet passing in high-eccentricity orbits in front of the star, thus accounting for the sudden changes.

Their calculations also put mass constraints on the planet (or planets) consumed. By their estimates, it was either a single Jupiter-sized planet, or a large number of smaller objects – such as moon-mass bodies that were about 1 km in diameter. This latter possibility seems more inviting, since a large number of objects would have produced a field of debris that would be more consistent with the dimming rate observed by previous studies.

These results are not only the best explanation of this star's strange behavior, they could have serious implications for the study of stellar evolution – in which stars gobble up some of their planets over time. As Brian D. Metzger, an assistant professor from the Columbia Astrophysics Laboratory and the lead author on the paper, explained in an interview with **New Scientist**:

"We estimated that if Tabby's star were representative, something like 10 Jupiters would have to fall into a typical star over its lifetime, or maybe even more... These transits only last a few days, so when we see one, we have to alert all the telescopes and basically point every telescope we have at Tabby's star."

No doubt, the mystery of Tabby's star will endure for some time to come. We can only hope that with ongoing observation, we might sort out exactly what is taking place in this far-flung system. But for the time being, the possibility that what are we seeing is the star returning to its normal state, and being occasionally dimmed by transiting pieces of debris, is the most plausible explanation yet.

Suffice it to say, the alien megastructure enthusiasts will likely be taking this latest study with a grain of salt! You have to admit, a megastructures is a VERY enticing possibility!

More information: Secular dimming of KIC 8462852 following its consumption of a planet. arxiv.org/pdf/1612.07332v1.pdf

Source: Phys.org Return to Contents

Space Image of the Week

Crescent Jupiter with the Great Red Spot

This image of a crescent Jupiter and the iconic Great Red Spot was created by a citizen scientist (Roman Tkachenko) using data from Juno's JunoCam instrument. You can also see a series of storms shaped like white ovals, known informally as the 'string of pearls.' Below the Great Red Spot a reddish long-lived storm known as Oval BA is visible.

The image was taken on Dec. 11, 2016 at 2:30 p.m. PST (5:30 p.m. EST), as the Juno spacecraft performed its third close flyby of Jupiter. At the time the image was taken, the spacecraft was about 285,100 miles (458,800 kilometers) from the planet.

JunoCam's raw images are available at www.missionjuno.swri.edu/junocam for the public to peruse and process into image products.

More information about Juno is online at http://www.nasa.gov/juno and http://missionjuno.swri.edu.

Source: NASA

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